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# Effects of Exposure to E-cigarette Advertising on Adolescents: A Systematic Review

Paayal Patel

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# Effects of Exposure to E-cigarette Advertising on Adolescents: A Systematic Review

By

Paayal Patel

December 12, 2017

## ABSTRACT

**INTRODUCTION:** With the use of e-cigarettes among adolescents rising dramatically in the past few years (Surgeon General, 2016), e-cigarettes have become “a major public health concern” (Surgeon General, 2016). E-cigarettes are now more frequently used among youth than conventional cigarettes (Surgeon General, 2016), with approximately 4 of every 100 middle school students (4.3%) and 11 of every 100 high school students (11.3%) reported past 30-day use in 2016—a substantial increase from 2011 (CDC, 2017). Although CDC recently reported that for the first-time e-cigarette use rates declined in 2016 (CDC, 2016), more than 2 million U.S. middle and high school students were using e-cigarettes in the past 30 days in 2016 (Gentzke, J., et al., 2017).

**AIM:** Although there have been many research studies that focus on tobacco advertising and adolescent smoking (Surgeon General, 2012), the literature on e-cigarette advertising effects on adolescents is just emerging. The current review aims to summarize this emerging literature on the relationship between e-cigarette advertising and adolescents’ perceptions, intentions, and behavior.

**METHODS:** A review of relevant literature

**RESULTS:** The findings of this systematic review did show there is a relationship between e-cigarette advertising and adolescents’ perceptual, intentional, and behavioral outcomes.

**DISCUSSION:** The results of this systematic review show effects of e-cigarette advertising on adolescents. Unregulated e-cigarette advertising may contribute to higher rates of e-cigarettes used by adolescents. Further research needs to be conducted to increase awareness about the negative effects associated with e-cigarette advertising.

Effects of Exposure to E-cigarette Advertising on Adolescents: A Systematic Review

by

Paayal Patel

B.S. Health Promotion, University of Georgia

A Capstone Submitted to the Graduate Faculty  
of Georgia State University in Partial Fulfillment  
of the  
Requirements for the Degree

MASTER OF PUBLIC HEALTH

ATLANTA, GEORGIA  
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APPROVAL PAGE

Effects of exposure to e-cigarette advertising on adolescents: A systematic review

by

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November 30, 2017  
Defense Date

## Author's Statement Page

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Paayal Dharmendra Patel  
Signature of Author

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## **I. Introduction**

With the use of e-cigarettes among adolescents rising dramatically in the past few years (Surgeon General, 2016), e-cigarettes have become “a major public health concern” (Surgeon General, 2016). E-cigarettes are now more frequently used among youth than conventional cigarettes (Surgeon General, 2016), with approximately 4 of every 100 middle school students (4.3%) and 11 of every 100 high school students (11.3%) reported past 30-day use in 2016—a substantial increase from 2011 (CDC, 2017). Although CDC recently reported that for the first-time e-cigarette use rates declined in 2016 (CDC, 2016), more than 2 million U.S. middle and high school students were using e-cigarettes in the past 30 days in 2016 (Gentzke, et al., 2017).

While e-cigarettes are arguably less harmful than combustible cigarettes, they contain harmful chemicals such as nicotine, carcinogens, heavy metals, and diacetyl (Surgeon General, 2017). More importantly, nicotine is highly addictive and can harm adolescent brain development (Surgeon General, 2017). Additionally, e-cigarette aerosol also contains cancer-causing chemicals that can harm the lungs (CDC, 2017). Furthermore, studies found that e-cigarettes predict future tobacco use. Studies have indicated that individuals who had used e-cigarettes were more likely to report cigarette smoking at follow-up. Both studies analyzed longitudinal data from a sample of high school students (Patrick, et al., 2017) (Wills, et al., 2015). These results elucidate e-cigarette use as a risk factor and a predictor for cigarette smoking among youth.

One of the reasons for growing rates of e-cigarette use among adolescents could be their exposure to widespread e-cigarette advertising. Extensive research has established a causal link



between exposure to cigarette advertising and adolescents' smoking-related perceptions, intentions, and behavior. More specifically, a meta-analysis of 51 studies (Wellman et al. 2006) found that exposure to tobacco marketing increased the odds of positive attitudes toward tobacco use as well as the odds of starting tobacco use among youth (Surgeon General, 2012). Furthermore, other studies have found that children that are exposed to tobacco promotion before they start using tobacco are more likely to initiate tobacco use (DiFranza, J. R., et al., 2006). An association between e-cigarette advertising and e-cigarette related outcomes in adolescents could be similar to the association between tobacco advertising and tobacco use among adolescents.

Spending on e-cigarette advertising costs has also rapidly risen in the past few years, tripling from \$6.4 million in 2011 to \$18.3 million in 2012 (CDC, 2017). As a result, approximately 7 in 10 middle and high students are exposed to e-cigarettes ads. According to the National Youth Tobacco Survey, 66% of middle school students and 71% of high school students saw at least one e-cigarette advertisement in 2014. During the same time that spending on e-cigarette advertisings have increased, e-cigarette use among US youth has increased as well, from less than 1% in 2011 to almost 4% in 2014 among middle school students and from less than 2% to 13% among high school students (CDC, 2017). More interestingly, e-cigarettes had become a \$2.5 billion industry in the United States by 2014 (Herzog B, Gerberi J and Scott A., 2014) and sales were projected to reach \$10 billion by 2017 (ACSP Health Digest, 2014). Although there have been many research studies that focus on tobacco advertising and adolescent smoking (Surgeon General, 2012), the literature on e-cigarette advertising effects on adolescents is just emerging. The current review aims to summarize this emerging literature on the relationship between e-cigarette advertising and adolescents' perceptions, intentions, and behavior.

## **II. Methods**

### **Inclusion Criteria**

Studies published in peer-reviewed journals that examined the relationship between e-cigarettes advertising (media, internet, television, retail, newspaper/magazines) and e-cigarette outcomes (e.g., behavior, susceptibility, perceptions) among adolescents were used in this review. I included quantitative and qualitative cross sectional, experimental, and longitudinal studies in this review. Any studies published after 2007 were included in this study. In 2007, e-cigarettes first entered the US market.

### **Participants**

I only examined studies that included middle school and high school students aged from 10-18 years old. Studies that included young adults and adults, but did not include adolescents were excluded from this systematic review. The selection was not limited geographically; studies with participants from any part of the world were included as long as they met other inclusion criteria.

### **Search Strategy**

In order to conduct the literature review, I used the following databases: Pubmed and Google Scholar. Within these databases, I used the following keywords and phrases: adolescents; e-cigarette advertising; e-cigarettes; vaping; electronic cigarettes; marketing; e-cigarette behaviors; e-cigarette marketing; e-cigarette intentions; e-cigarette susceptibility; e-cigarette and media; e-cigarette and retail; adolescent vaping; exposure; and television. After looking for research articles utilizing the various databases, I looked through the reference lists

for the studies I identified those that were specific to e-cigarette advertising and e-cigarette outcomes. I also looked through the reference lists for studies that focused on e-cigarette use but not necessarily among adolescents. After searching the reference lists, I googled the same terms as listed above to see if I could find any articles that I missed in Google Scholar and PubMed.

### **Types of outcomes measures**

I used the message impact framework to classify the outcomes along the 3 main constructs: perceptions, intentions, and behavior. The framework is based on communication and psychological theory (Noar SM, et al., 2015). The first group of outcome consisted of perceptions related to e-cigarettes. This included knowledge, attitudes, and beliefs about e-cigarettes. The second group of outcome were intentions to start e-cigarette use. Lastly, the third group was behavior which consisted of e-cigarette use (Noar SM, et al., 2015).

## 1.1 Table: Message Impact Framework

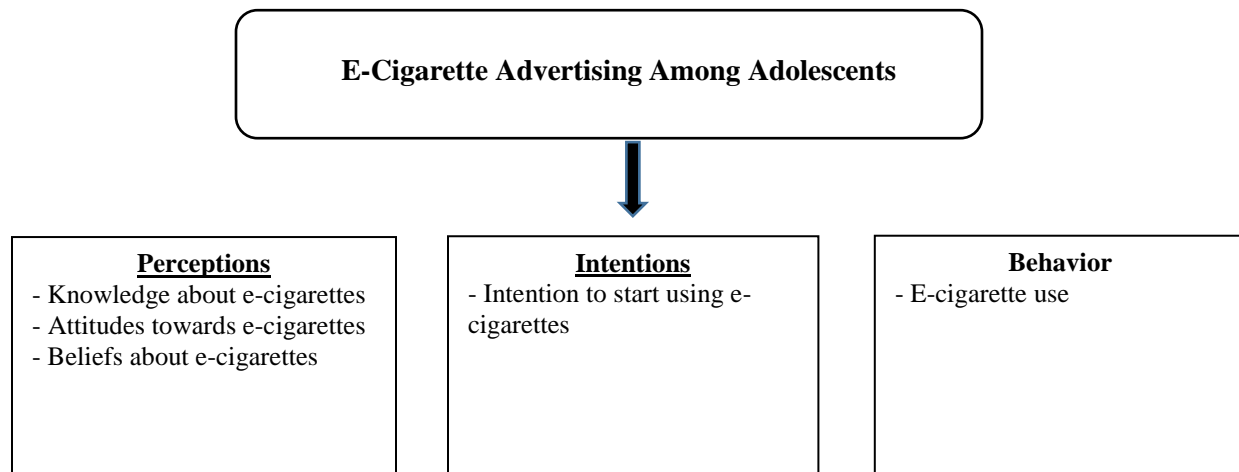


Table 1.2: Research Articles used in the Systematic Review

Study	Study design	Participants	E-cigarette exposure	Perceptions Measures	Perceptions results	Intentions measures	Intentions results	Behavior measures	Behavior results
Dai & Hao, 2017.	Cross-sectional survey	22,007 US middle and high school adolescents (2014 NYTS)	Self-reported exposure on the internet, newspapers/magazines, stores, TV/movies (high, medium, low levels)	N	N	N	N	E-cigarette use: Former: ever, but not past 30 days; Current: past 30 days. For current users, heaviness of use (low, medium, high)	Former use associated with medium exposure over the internet and both medium and high exposure in stores. Current use associated with high and medium exposure over internet and in stores. High level of e-cigarette use was associated with newspaper advertisements only. (Adjusted analyses)
Pu, J., & Zhang, X., 2017.	Cross-sectional study	22,007 US middle and high school adolescents (2014 NYTS)	Self-reported exposure on the internet, newspapers/magazines, TV/movies	Perceived risk (“Do you believe that e-cigarettes are less harmful, equally harmful or more harmful than regular cigarettes?” Addictiveness of e-cigarettes	Exposure to newspaper/magazines was associated with lower likelihood of perceiving e-cigarettes to be less harmful/addictive while exposure to internet was associated with higher likelihood of perceiving e-cigarettes to be less harmful/addictive.	“Do you think that you will try an electronic cigarette or e-cigarette soon?”	Exposure to internet was highly associated with intent to use e-cigarettes among adolescent who have never used e-cigarettes, while exposure via television was associated with low intent to use e-cigarettes.	Current e-cigarette user: if he/she reported ‘one day or more’ to the following question: “During the past 30 days, on how many days did you use electronic cigarettes or e-cigarette such as Blu, 21st Century Smoke, or NJOY?”	Exposure via retail was associated with higher likelihood of current e-cigarette use while exposure via television and newspaper/advertisements was associated with lower likelihood or current e-cigarette use.
Mantey, D. S., Cooper, M. R., Clendenen, S. L., Pasch, K. E., & Perry, C. L., 2016.	Cross-sectional study	22,007 US middle and high school adolescents (2014 NYTS)	Self-reported exposure on the internet, newspapers/magazines, TV/movies	N	N	“Do you think you will try an electronic cigarette or e-cigarette soon?”, “Have you ever been curious about using an electronic cigarette or e-cigarette such as Blu,	In multivariate models, as the number of channels of e-cigarette marketing exposure increased, the likelihood of susceptibility also increased. Exposure to internet was significantly associated	Ever use of e-cigarettes assessed by “yes” or “no”, Current e-cigarette user assessed by “During the past 30 days, on how many days did you use e-cigarettes or e-cigarettes such as Blue, 21st	Current e-cigarette use was significantly associated with exposure via internet. Ever e-cigarette use was significantly associated with exposure via

						21st Century Smoke, or NJOY?" and "If one of your best friends were to offer you an electronic cigarette or e-cigarette, would you use it?"	with susceptibility to e-cigarettes.	Century Smoke or NJOY?" Participants responding with anything greater than "0" considered to be a current user.	internet and in retail stores.
Giovenco, D. P., Casseus, M., Duncan, D. T., Coups, E. J., Lewis, M. J., & Delnevo, C. D., 2016.	Cross-sectional study	3,909 US high school adolescents (NJYTS)	E-cigarette promotion in retail stores, more specifically, all stores within a half-mile of schools	N	N	N	N	Ever e-cigarette use, "Have you ever used an e-cigarette?" "Yes" or "No." Past-month e-cigarette use, "During the past 30 days, on how many days did you use an e-cigarette?" Response greater than zero were considered past-month e-cigarette users.	E-cigarette advertising volume significantly increased the probability of being a past-month e-cigarette user (adjusted prevalence ratio: 1.03, p = .031). Only e-cigarette retailer density near schools, not advertising volume, was associated with ever use.
Singh, T., Agaku, I. T., Arrazola, R. A., Marynak, K. L., Neff, L. J., Rolle, I. T., & King, B. A. (2016)	Cross-sectional study	22,007 US middle and high school adolescents (2014 NYTS)	Self-reported exposure on the internet, newspapers/magazines, TV/movies	N	N	N	N	Current e-cigarette users, "During the past 30 days, on how many days did you use electronic cigarettes or e-cigarettes such as Blu, 21st Century Smoke, or NJOY?" Respondents who answered $\geq 1$ days in the past 30 days were considered current e-cigarette users; those who answered 0 days in the past 30 days were considered as not current e-cigarette users.	Among middle school students, greater exposure to e-cigarette advertisements on the Internet and in retail stores were associated with higher odds of use. Among high school students, greater exposure to e-cigarette advertising from all 4 sources was associated with higher odds of use.

Farrelly, M. C., Duke, J. C., Crankshaw, E. C., Eggers, M. E., Lee, Y. O., Nonnemaker, J. M., & Porter, L. (2015)	Experiment Study	3,655 US middle and high school adolescents	Exposure to four advertisements: Two 60-second advertisements for the brand blu e-Cigs, one 60-second advertisement for the brand NJOY, and one 30-second advertisement for the brand 21st Century	N	N	“Do you think you will try an e-cigarette soon?” “Do you think you will try an e-cigarette anytime during the next year?” and “If one of your best friends were to offer you an e-cigarette, would you use it?”	ORs (treatment group) were 1.54 for trying an e-cigarette soon; 1.43 for trying an e-cigarette within the next year; and 1.29 for trying an e-cigarette if a best friend offered one.	N	N
Duke, J. C., Allen, J. A., Eggers, M. E., Nonnemaker, J., & Farrelly, M. C., (2015)	Experiment Study	5020 US middle and high school adolescents	Advertisements included two 60-second advertisements for the brand blu e-Cigs, one 60-second advertisement for the brand NJOY, and one 30-second advertisement for the brand 21st Century.		Among never e-cigarette users, greater PE was associated with more positive attitudes toward e-cigarettes (b = 0.74, P < .001)	“Do you think you will try an e-cigarette soon?” “Do you think you will try an e-cigarette anytime during the next year?” and “If one of your best friends were to offer you an e-cigarette, would you use it?”	Among never e-cigarette users, intentions to use e-cigarettes (b = 0.16, P < .001).	N	N
Nicksic, N. E., Harrell, M. B., Pérez, A., Pasch, K. E., & Perry, C. L., 2017.	Longitudinal Study	3907 US middle and high school adolescents	Self-reported exposure to TV, radio, billboards, retail stores, and internet	Perceived risk: “How harmful are electronic cigarettes, vape pens, or e-hookah to health?”	Students who recalled e-cigarette advertising on TV, the odds of perceiving no harm from e-cigarettes at follow-up was 1.49 times higher compared to those who did not recall these advertisements.	“Have you ever been curious about using electronic cigarettes, vape pens, or e-hookahs?” “Do you think you will use any of the following products in the next 12 months?” and “If one of your close friends were to offer you one of the following products, would you use it?”	Students who recalled advertisements via retail stores and the Internet at baseline, had higher odds of being susceptible to e-cigarette use (1.77 and 1.72 times higher at follow-up) compared to those who did not recall these advertisements.	Ever e-cigarette, “Have you EVER used an electronic cigarette, vape pen, or e-hookah, even one or two puffs?” Current e-cigarette use, “DURING THE PAST 30 DAYS, on how many days did you use an electronic cigarette, vape pen, or e-hookah? Response with 1 or >1 considered current users.	Students who recalled advertisements via TV and retail stores, the odds of ever e-cigarette use was 1.60 and 1.51 times higher compared to those who did not recall these advertisements. Among students who recalled retail store and internet advertisements at baseline, the odds of current e-cigarette use was 2.03 and

									2.17 times higher.
Agaku, I. T., & Ayo-Yusuf, O. A. (2014)	Cross-sectional study	18,866 middle and high school adolescents	Self-reported exposure to pro-tobacco advertisements over the Internet, in newspapers/magazines, and at retail stores	N	N	N	N	Experimentation with e-cigarettes was defined as a report by a student that they had ever used the respective tobacco products at least once during their lifetime.	The odds of experimenting with e-cigarettes were 1.35 times higher for students exposed to one, two, or all three types of pro-tobacco advertisements, respectively, compared with those exposed to none



### **III. Results**

The systematic review identified nine studies that focused on e-cigarette advertising and adolescent outcomes - six cross-sectional (Pu, J., & Zhang, X., 2017; Dai, H., & Hao, J., 2016; Mantey, D. S., Cooper, et al., 2016; Giovenco, D. P., et al., 2016; Singh, T. et al., 2016; Agaku, I. T., & Ayo-Yusuf, O. A., 2014) two experimental (Farrelly, M. C., et al., 2015; Duke, J. C., 2015) and 1 prospective (Nicksic, N. E., et al., 2017).

#### **Cross-Sectional Studies**

Six out of the eight studies were cross-sectional studies (Pu, J., & Zhang, X., 2017, Dai, H., & Hao, J., 2016, Mantey, D. S., Cooper, et al., 2016, Giovenco, D. P., et al., 2016, Singh, T. et al., 2016, Agaku, I. T., & Ayo-Yusuf, O. A., 2014). Four of these studies utilized the 2014 National Tobacco Youth Survey, an ongoing survey that studied tobacco-related knowledge, attitudes, and behaviors of students in middle school (grades 6-8) and high school (9-12) from 50 states and the District of Columbia. In the 2014 NYTS survey, 207 schools and 22,007 students completed the questionnaires yielding an overall response rate of 73.3%. One of the cross-sectional studies (Agaku, I. T., & Ayo-Yusuf, O. A., 2014) utilized the 2011 National Youth Tobacco survey. Participants included 18,866 students sampled from 178 schools, yielding an overall response rate of 72.7%.

Lastly, the fifth cross-sectional study (Giovenco, D. P., et al., 2016) utilized the 2014 New Jersey Youth Tobacco Survey that occurred between October and December 2014 in 41 New Jersey high schools. The survey included a total number of 3,909 students that completed a survey, an average of 97 students per school.

## **Experimental Studies**

Two of the eight publications I found were experimental studies (Farrelly, M. C., et al., 2015, Duke, J. C., 2015), using the same study conducted in May 2014 with a convenience sample of 5,020 US adolescents aged 13-17. For the first experimental study, participants included 3,655 U.S. adolescents aged 13-17 years old who had never tried e-cigarettes ((Farrelly, M. C., et al., 2015). The second experimental study included the full sample of 5,020 adolescents aged 13-17 (Duke, J. C., 2015).

## **Longitudinal study**

The last study was a prospective longitudinal study (Nicksic, N. E., et al., 2017). Participants consisted of 3,907 students who participated in a youth tobacco surveillance study in 2014-2015 (2,488 students who completed a 6-month follow-up). The study used TATAMS (The Texas Adolescent Tobacco and Marketing Surveillance) system, a rapid response surveillance system that followed 6<sup>th</sup>, 8<sup>th</sup>, and 10<sup>th</sup> grade students who are 12-17 year olds enrolled in 79 middle and high schools in 5 counties surrounding the 4 most populated cities in Texas. These cities included: Austin, Houston, Dallas Ft. Worth, and San Antonio.

## **Measures of E-cigarette Advertising Exposure**

In regards to measures of e-cigarette advertising exposure, five cross-sectional studies (Pu, J., & Zhang, X., 2017, Dai, H., & Hao, J., 2016, Mantey, D. S., Cooper, et al., 2016, Giovenco, D. P., et al., 2016, Singh, T. et al., 2016; Agaku, I. T., & Ayo-Yusuf, O. A., 2014) relied on self-reports of recalled exposure.

The primary sources of e-cigarette advertisements were television, internet, newspaper/magazines, and retail stores. Exposure to e-cigarette ads were measured by asking participants: “When you are using the Internet, how often do you see ads or promotions for electronic cigarettes or e-cigarettes?” and “When you read newspapers or magazines, how often do you see ads or promotions for electronic cigarettes or e-cigarettes?” Response options included “never,” “rarely,” “sometimes,” “most of the time,” or “always.”

For the cross-sectional study that used data from the New Jersey Youth Tobacco Survey (Giovenco, D. P., et al., 2016), the ‘placement’ included e-cigarette promotion in retail stores. More specifically, stores within a half-mile of schools that were visited between March and June 2015. Researchers collected data on the number of e-cigarette advertisements on a store’s exterior and interior using a survey instrument (used an objective measure of exposure such as actual counts of ads). Each school was allocated two advertising scores: the total number of e-cigarette advertisements within a half-mile and a weighted measure of e-cigarette advertising volume.

Both (Farrelly, M. C., et al., 2015, Duke, J. C., 2015) employed the same e-cigarette advertising exposure. Participants were exposed to 4 advertisements: two 60-second advertisements for the brand blu e-cigarettes, one 60-second advertisement for the brand NJOY, and one 30-second advertisement for the brand 21<sup>st</sup> century. Key advertising messages included the following: e-cigarettes are safer than cigarettes, e-cigarettes can be used where cigarettes are not allowed, e-cigarette vapor does not negatively affect others around a user, using e-cigarette feels like smoking conventional cigarettes, and using e-cigarettes results in a greater freedom and independence. Participants in the treatment condition were exposed to the advertisements first,

then answered the questions about outcomes. In the control condition, participants answered questions about the outcomes before viewing the advertisements.

For the longitudinal study (Nicksic, N. E., et al., 2017), five communication channels (TV, radio, billboards, retail stores, and internet) were considered for exposures to e-cigarette advertisements. Participants were asked: “How often do you see or hear any advertisements or promotions for electronic cigarettes, vape pens, or e-hookah on...Television shows (TV or online)? Radio/Internet Radio? Billboards?” Responses included: “Never,” “Rarely,” “Occasionally,” “Frequently,” and “Very Frequently.” The following questions on retail stores were also asked: “When you visited gas stations, convenience stores and/or grocery stores, how often did you see signs marketing electronic cigarettes, vape pens, or e-hookah?” Responses included: “Never/not that I remember,” “Some of the time you were in a store,” “Most of the time you were in a store,” and “Every time you were in a store.” Lastly, all students were asked: “Where do you remember seeing advertisements for electronic cigarettes, vape pens, or e-hookah?” “For example, students who checked “Internet” were considered exposed to e-cigarette advertisements on the Internet, whereas students who did not check were not exposed” (Nicksic, N. E., et al., 2017). A continuous index score was created as the sum of the responses from the 5 dichotomous exposures, where each student could score between a 0 and 5.

### **E-cigarette Advertising and Perceptions / Attitudes**

I found three studies that examined the relationship between exposure to e-cigarette advertising and perceptions. One is a cross-sectional study (Pu, J., & Zhang, X., 2017), the second is an experimental study (Duke, J. C., Allen, J. A., Eggers, M. E., Nonnemaker, J., & Farrelly, M. C., (2015), and the third is a longitudinal study (Nicksic, N. E., et al., 2017).

The longitudinal study found that while the “recall of e-cigarette advertising was not significantly associated with perceived harm at baseline after adjusting for covariates,” “among students who recalled e-cigarette advertising on TV at baseline, the odds of perceiving no harm from e-cigarettes at follow-up was 1.49 times higher compared to those who did not recall these advertisements, after adjusting for covariates” (Nicksic, 2017). Thus said, there is a significant relationship between exposure and follow-up perceptions. On the other hand, the cross-sectional study found that “exposure via newspaper/magazines and TV was associated with lower likelihood of perceiving e-cigarettes to be less harmful or addictive” while exposure via retail stores was associated with higher likelihood of current e-cigarette use and perception of reduced harmfulness of e-cigarettes compared to regular cigarettes ( $p < .05$ ) (Pu, J. and Zhang, X., 2017),

Lastly, in the experimental study, attitudes towards e-cigarette advertisements were measured after participants were exposed to the e-cigarette advertisements. The results found that “after ad exposure, youth who have never used e-cigarettes previously perceive e-cigarettes as cooler, more fun, healthier, and more enjoyable (Duke, et al., 2015). This study, however, only focused on TV advertisements while the other two studies gather data for 4 common advertising outlets (television, internet, newspaper/magazines, and retail stores).

Three studies examined the relationship between exposure to e-cigarette advertising and perceptions one cross-sectional study (Pu, J., & Zhang, X., 2017), one experimental study (Duke, J. C., Allen, J. A., Eggers, M. E., Nonnemaker, J., & Farrelly, M. C., (2015), and one longitudinal study (Nicksic, N. E., et al., 2017). Findings for perceived harm were mixed. Exposure to e-cigarette advertisements was associated with lower perceived harm in a longitudinal study (Nicksic, N. E., et al., 2017), where recall of e-cigarette advertising was prospectively associated with lower perceived harms of e-cigarettes six months later, and in a

cross-sectional study - exposure to advertisements via internet and in retail stores was associated with lower perceived harm. However, in the cross-sectional study, the relationship differed by the media of advertising – where the exposure via newspapers/magazines and TV was associated with higher perceived harm (Pu, J., & Zhang, X., 2017). Moreover, although perceived harm was not measured in the experimental study, results stated that more positive attitudes towards e-cigarettes were reported among e-cigarette never users (Duke, J. C., et al., 2015).

### **E-cigarette Advertising and Susceptibility / Intentions**

I found five studies that examined the relationship between exposure to e-cigarette advertising and susceptibility to using e-cigarettes and intentions to use e-cigarettes in the future. One is a longitudinal study (Nicksic, N. E., et al., 2017), two are cross-sectional studies (Mantey, D. S., Cooper, et al., 2016, Pu, J., & Zhang, X., 2017), and two are experimental studies (Farrelly, M. C., et al., 2015, Duke, J. C., 2015).

For the longitudinal study, the odds of being susceptible to e-cigarette use were highest for participants that were exposed to Internet vs. other advertising outlets. Furthermore, this study also found that “among students who recalled advertisements via retail stores and the Internet at baseline, the odds of being susceptible to e-cigarette use was 1.77 and 1.72 times higher, respectively, at follow-up compared to those who did not recall these advertisements, after adjusting for covariates” (Nicksic, N. E., et al., 2017). More interestingly, “susceptibility to e-cigarette use at baseline also was significantly associated with e-cigarette ever use 6 months later (OR=6.88, 95% CI 3.42-13.81)” (Nicksic, N. E., et al., 2017).

For the cross-sectional study, “among youth who had never used e-cigarettes, exposure to e-cigarette marketing via internet, print, retail, and TV/movies was significantly associated with

susceptibility to e-cigarette use.” More interestingly, “among adolescents who had never used e-cigarettes, each additional exposure to a channel of e-cigarette advertising, students’ odds of susceptibility to e-cigarette use increased by 1.11” (Mantey, D. S., Cooper, et al., 2016).

Susceptibility of e-cigarette use was highly associated with exposure to internet and print/newspaper. In the second cross-sectional study, exposure to internet was also highly associated with intent to use e-cigarettes among adolescent who have never used e-cigarettes, while exposure via television was associated with low intent to use e-cigarettes (Pu, J., & Zhang, X., 2017).

In one of the experimental study, “odds ratios for the treatment group ranged from 1.54 ( $p=0.001$ ) for trying an e-cigarette soon to 1.29 ( $p=0.02$ ) for trying an e-cigarette if a best friend offered one” (Farrelly, M. C., et al., 2015). For the other experimental study, “youth who thought the ads were more effective were more likely to have a positive attitude toward e-cigarettes and greater intention to try e-cigarettes in the future” (Duke, J. C., 2015).

Overall the studies consistently show that exposure to e-cigarette advertising is related to greater susceptibility and intentions to use e-cigarettes. In the first two cross-sectional studies, results were very familiar. Exposure to internet was associated with susceptibility of e-cigarette and intent to use e-cigarettes.

### **E-cigarette Advertising and E-cigarette Use**

I looked at seven studies that investigated the relationship between exposure to e-cigarette advertising and the use of e-cigarettes among adolescents. Four out of seven studies utilized data from the 2014 National Youth Tobacco Survey. One out of seven studies utilized data from the 2011 National Youth Tobacco Survey. The other two studies used data from a

rapid response surveillance system that follow students at baseline in populous cities in Texas and from a New Jersey National Tobacco Survey dataset. As mentioned previously, for the studies that utilized data from the 2014 National Youth Tobacco Survey and 2011 National Youth Tobacco Survey had the same measures of exposure.

All studies found a relationship between exposure to e-cigarette advertising and use of e-cigarettes. More specifically, studies found the odds of e-cigarette use among adolescents to be between 1.0 and 3.1 greater with exposure to e-cigarettes. For example, in one particular study, “among students who recalled advertisements in retail stores, the odds of current e-cigarette use was 2.21 times higher at baseline compared to those who did not recall retail store advertisements, after adjusting for covariates” (Nicksic, et al., 2017). Furthermore, “among students who recalled retail store and internet advertisements at baseline, the odds of current e-cigarette use was 2.03 and 2.17 times higher, at follow-up compared to those who did not recall these advertisements, after adjusting for covariates” (Nicksic, et al., 2017). Overall, six out of seven studies found that e-cigarette advertisement exposure on the Internet, in newspapers/magazines, in retail stores, and in TV/movies is associated with current e-cigarette use among US middle and high school students. Moreover, “greater exposure is associated with higher odds of use” (Singh, et. al., 2016).

More interestingly, six out of seven studies found that participants that were exposed to e-cigarette advertisement via Internet had the highest odds ratio for current e-cigarette use compared to other advertising outlets. The odds ratio ranged from 1.68 to 3.1 for the current use of e-cigarettes with exposure to e-cigarette ads from the Internet. Furthermore, one of the cross-sectional studies found that “students who were exposed most of the time/always to retail or Internet pro-tobacco advertisements were more likely to experiment with e-cigarettes compared



with those who were not exposed to the advertisements” (Agaku, I. T., & Ayo-Yusuf, O. A., 2014).

However, one study that specifically focused on retail environments found that “for every additional e-cigarette retailer within a half-mile of a school, the probability of a student at that school being a past-month e-cigarette user increased by 4% ( $p = .009$ ). For every additional e-cigarette advertisement, the student saw on the store’s exterior and interior, the probability of past-month e-cigarette use increased by 1% ( $p = .031$ ) (Giovenco, et al., 2016).

Lastly, the results were consistent across the cross-sectional studies. All studies showed an association between e-cigarette use and e-cigarette advertising (regardless of what the advertisement placements were).

## **V. Discussion**

The findings of this systematic review did show there is a relationship between e-cigarette advertising and adolescents' perceptual, intentional, and behavioral outcomes. For the studies that utilized the 2014 National Youth Tobacco Survey, e-cigarette advertisements was associated with adolescents' use and perceptual of e-cigarettes. For the study that utilized the 2014 New Jersey Tobacco Survey, presence of retailers around the schools was positively associated with e-cigarette use among students. For the prospective longitudinal study, recall of e-cigarette advertisements at point-of-sale and on the Internet was associated with adolescent e-cigarette use and susceptibility. Lastly, one of the two experimental studies concluded that the findings suggested that e-cigarette advertising is influencing adolescents to use e-cigarettes (Duke, J. C., 2015). Taken together, these results indicate that exposure to e-cigarette advertising may contribute to higher use of e-cigarettes among adolescents.

Ultimately, stricter regulations need to be implemented in order to reduce e-cigarette advertising and adolescent use of e-cigarettes. Additional research is also necessary and imperative to further investigate if a causal relationship exists between e-cigarette advertising and e-cigarette outcomes. More specifically, more longitudinal studies are needed on this type of relationship to provide more detailed results.

### **Limitations of Systematic Review**

One of the main limitation of this study is that this review does not include a PRISMA flow diagram. A PRISMA flow diagram illustrates the flow of information of a systematic review. It includes the number of studies identified, included, and excluded in the review. A visual representation of databases and other information sources used to identify relevant studies

would be beneficial to the readers. The second limitation is that this review only included studies with adolescents. Moreover, future research would benefit from the use of a larger sample of participants by including young adults and older adults. By incorporating young and older adults, researchers could also see if results are varying between adults vs. adolescents.

### **Limitations of Current Research**

This systematic review revealed several limitations of the current research on the association between e-cigarette advertising and adolescents' perceptions and behaviors. First, majority of the studies included in this review were cross-sectional studies. There was only 1 prospective longitudinal study included in this review. Furthermore, although this longitudinal study measured perceptions at baseline and correlated them with perceptions, intentions, and behavior at the follow up, it did not fully control for other extraneous factors that might have accounted for the association. Some third variable (such as parental tobacco use, peer use of e-cigarettes, number of retailers around schools, etc.) might have explained both greater exposure at baseline and also greater perceptions, intentions, and behavior at the follow-up.

Additionally, longitudinal prospective studies show strong variable patterns over time. When advertisements change over time, these studies can provide more accurate results and identify changes in the behaviors and attitudes of individuals.

Majority of the studies included used the 2014 National Youth Tobacco Survey data. Because the data are cross-sectional, it is difficult to establish causal inferences. Furthermore, the exposure to advertisements was self-reported meaning that recall bias could have also existed in these studies. In order to generate precise results, more longitudinal studies are needed to study the relationship between the two variables. While cross-sectional studies are beneficial, very

little research has been done prospectively or using experimental design (only one study). A cause-and-effect relationship can easily be established in an experimental study vs. cross-sectional study.

One of the other limitations for the studies that utilized the 2014 New Jersey Tobacco Survey is that the store audit data was collected 3-5 months after survey administration. That being said, the marketing documented during the retailer visits may not have represented the point-of-sale environment during the months of survey data collection. In order to avoid this in the future, data can be collected in a timely manner so results can be accurate. Second limitation is that the researchers did not collect detailed information about the content of each advertisement. This can be improved by asking descriptive and thorough questions. These should be well thought out prior to asking participants. Lastly, for the prospective longitudinal study, some of the limitations included self-reported measures with direct observation and selection bias. “Although longitudinal data help strength casual inference, selection bias cannot be completely removed” (Nicksic, 2017).

## **VI. Conclusion**

The results of this systematic review show effects of e-cigarette advertising on adolescents. Unregulated e-cigarette advertising may contribute to higher rates of e-cigarettes used by adolescents. Further research needs to be conducted to increase awareness about the negative effects associated with e-cigarette advertising. More importantly, federal government can support state tobacco prevention programs to prevent adolescent use of tobacco and e-cigarette products as well as control mass media campaigns directed towards e-cigarette use (CDC, 2017). Furthermore, states and communities can also restrict the number and type of e-cigarette marketing at retail and grocery stores.

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